

during which time 1.25 inches of rain fell. Hail fell for five minutes, the hail-stones measuring one-quarter of an inch in diameter; in the outskirts of the city the hail was of much larger size. Hillsborough, Hill Co., Tex.: a large number of buildings were wrecked or damaged by a tornado which occurred here at 7 a. m. The damage is estimated at \$100,000. Davenport, Iowa: the rain and hail storm in the afternoon caused damage in this vicinity to buildings, crops, etc., estimated at \$50,000 or \$60,000. The storm began at 3 o'clock and continued for about twenty minutes. Elgin, Kane Co., Ill.: at 5.30 p. m. a destructive hail storm occurred. The hail-stones were of remarkable size and broke large quantities of window glass. Reports from Galesburg, Knox Co., state a hail storm occurred at that place also. Memphis, Tenn.: the storm on the night of the 27-28th caused no damage at this place, but reports show that it was very destructive in other parts of the state. Reports from Holly Springs, Miss., state that the storm was unusually severe in that vicinity. Des Moines, Iowa: during the night of the 27-28th South Des Moines, Sevastopol, and Bloomfield townships were visited by a very destructive storm. Hail fell in large quantities, some of the hail-stones being unusually large.

28th. Chambersburg, Franklin Co., Pa.: about 4 p. m. a terrific hail storm passed over this place. The hail-stones were unusually large and of irregular shapes. Large quantities of window glass were destroyed, and persons and animals were seriously cut and bruised by the falling hail. Canton, Stark Co., Ohio: at about noon a severe storm passed over this place, causing damage estimated at \$60,000, \$50,000 of this amount being sustained by the New Hampden watch factory, the south wing of which was destroyed. Savona, Steuben Co., N. Y.: about 5 p. m. severe and destructive local storms occurred in this and neighboring counties. Reports from Cameron Mills, in Steuben Co., Wellsville, Alleghany Co., Olean, Cattaraugus Co., and Elmira, Chemung Co., show that storms of unusual severity occurred at those places, causing damage to a greater or less extent. The "New York World" of the 29th states that twenty business blocks at Waterville were unroofed, and that a church and several other buildings at Allentown, Alleghany Co. were wrecked. Wheeling, West Va.: severe local storms occurred in this part of the state, and in some places they were accompanied by hail. Much damage

was done by lightning. Cadiz, Harrison Co., Ohio: a storm of great severity prevailed at this place in the afternoon, causing damage to many buildings. Eden, Erie Co., N. Y.: about 7 p. m. a hail storm occurred here, the hail-stones being of considerable size; the storm was about of twenty minutes duration. Oil City, Pa.: a violent and destructive storm occurred here at between 2.30 and 3 p. m. Remarkably severe storms also occurred at other points in this and neighboring counties, and, in some instances, the characteristics of tornadoes were apparent. In the vicinity of Clintonville, Venango Co., numerous derricks and out-houses were blown down. Similar damage was also done at Fern and vicinity, in Clarion Co., and at Titusville, Crawford Co. Zanesville, Muskingum Co., Ohio: the storm which passed over this section in the morning was of unusual severity. At Gaysport three spans of a new bridge were carried away.

31st. Cartwright's Wharf, Nansemond Co., Va.: about 4 p. m. a storm passed over this place, moving in a northeasterly direction, blowing down many trees and causing damage to buildings.

#### WATER-SPOUTS.

Capt. C. H. Hossack, of the s. s. "Saint Asaph," reports: "May 1st, 5 p. m., in N. 27° 52', W. 79° 41', observed one large and six small water-spouts; the former appeared large at the clouds and got gradually smaller as it neared the surface of the sea, where it ended in a long curve from ne. to sw. On looking at it with glass, it seemed spiral in shape and travelling from e. to w.; although only about one mile distant, could see no ascending currents. The smaller spouts appeared to be within one-eighth of a mile of each other and distant about seven miles from the ship. They seemed large at the clouds, decreasing in size toward the centre, and increasing at the base, and were travelling from e. to w. Barometer and thermometer steady, no fluctuation in either observable."

Capt. J. W. Tobin, of the s. s. "Alps," reports: "Near Jamaica, W. I., May 10th, between 4 and 5 p. m. (Greenwich time) observed eight or ten water-spouts to the westward; at 5 p. m. was struck by a heavy squall of rain, with wind-force about 9, from se., lasting three hours, after which dirty weather continued until we were well to the northward of the Bahama Banks. There was no notable change in the barometer."

#### INLAND NAVIGATION.

##### OPENING OF NAVIGATION—ICE IN RIVERS AND HARBORS.

*Strait of Macinac.*—Saint Ignace, Macinac Co., Mich.: on the 1st there were from twenty to thirty ice-bound vessels between Waughoshance Light and Saint Helena's Island. The ice in the strait broke during the 4th and a large fleet passed through. The following table, showing the dates of the opening of Mackinac Strait for each season since 1854, is from the "Chicago Inter-Ocean" of May 5, 1888:

Year.	Date.	Year.	Date.
1854	April 25	1872	April 28
1855	May 1	1873	May 1
1856	May 2	1874	April 29
1857	May 1	1875	April 28
1858	April 6	1876	April 20
1859	April 4	1877	Mar. 14
1860	April 13	1878	April 23
1861	April 25	1879	April 5
1862	April 18	1880	May 3
1863	April 17	1881	April 4
1864	April 23	1882	April 5
1865	April 21	1883	April 28
1866	April 29	1884	April 28
1867	April 23	1885	May 6
1868	April 19	1886	April 21
1869	April 23	1887	April 23
1870	April 18	1888	May 4
1871	April 3		

The remarkably early opening of 1878 (March 14) was seven weeks in advance of the present season.

*Lake Erie.*—Buffalo, N. Y.: floating ice on the 1st; lake full of ice on 10th.

*Lake Michigan.*—Milwaukee, Wis.: the ice in the strait of Macinac broke up on the 3d, and vessels on both sides passed through. The steamer "Oswego" reached this point at 11 p. m., being the first arrival of the season from the lower lakes.

*Green Bay.*—Green Bay, Wis.: the steamer "Welcome" which cleared on the 2d was the first departure of the season; the first arrivals were the steamers "Middlesex" and "De Pere," on the 4th.

*Lake Superior.*—Duluth, Minn.: the steam barge "Kosato," from Buffalo, N. Y., arrived on the 12th, and the propeller "Freemont" cleared on same date. There was much broken ice in the lake on the 22d, rendering navigation dangerous.

Marquette, Mich.: the harbor was cleared of ice by a strong westerly wind during the night of the 4-5th. The steamer "Toledo" arrived on the 11th, being the first boat of the season.

*Devil's Lake.*—Fort Totten, Dak.: the ice in the lake broke during the morning of the 10th, and by 9 a. m. had entirely disappeared. Steamer "Minnie H." made her first trip this season on the 11th.

*Missouri River.*—Poplar River, Mont.: the steamer "Batchelor" arrived on 25th, being the first arrival of the season.

#### STAGE OF WATER IN RIVERS AND HARBORS.

In the following table are shown the danger-points at the

various stations, the highest and lowest depths for May, 1888, with the dates of occurrence and the monthly ranges:

*Heights of rivers above low-water mark, May, 1888 (in feet and tenths).*

Stations.	Danger-point on gauge.	Highest water.		Lowest water.		Monthly range.
		Date.	Height.	Date.	Height.	
<i>Red River:</i>						
Shreveport, La. ....	29.9	19	30.3	4	20.6	9.7
<i>Arkansas River:</i>						
Fort Smith, Ark. ....	22.0	21	17.8	16	4.6	13.2
Little Rock, Ark. ....	23.0	23	18.4	16, 17	5.9	12.5
<i>Missouri River:</i>						
Omaha, Nebr. ....	18.0	30	13.1	6	9.5	3.6
Leavenworth, Kans. ....	20.0	31	16.5	22	12.2	4.3
<i>Mississippi River:</i>						
Saint Paul, Minn. ....	14.5	11	14.1	24	10.2	3.9
La Crosse, Wis. ....	24.0	8, 9	15.7	25	12.0	3.7
Dubuque, Iowa ....	16.0	12, 13	22.4	29, 30	15.8	6.6
Davenport, Iowa ....	15.0	15, 16	18.6	31	13.0	5.6
Keokuk, Iowa ....	14.0	16	19.6	6	15.3	6.0
Saint Louis, Mo. ....	32.0	31	28.9	1, 2, 3	21.6	7.3
Cairo, Ill. ....	40.0	31	31.1	11	23.8	7.3
Memphis, Tenn. ....	34.0	31	25.2	6, 7, 12, 13	20.0	5.2
Vicksburg, Miss. ....	41.0	1	43.6	21, 22	27.4	16.2
New Orleans, La. ....	13.0	3	14.8	23, 24	10.9	3.9
<i>Ohio River:</i>						
Pittsburg, Pa. ....	22.0	20	9.3	5	2.8	6.5
Cincinnati, Ohio ....	50.0	28	18.0	8, 10, 11	9.7	8.3
Louisville, Ky. ....	25.0	29	8.0	12, 13	5.7	2.3
<i>Cumberland River:</i>						
Nashville, Tenn. ....	40.0	29	8.8	15, 16	3.4	5.4
<i>Tennessee River:</i>						
Chattanooga, Tenn. ....	33.0	25, 26	9.6	8	4.0	5.6
<i>Monongahela River:</i>						
Pittsburg, Pa. ....	29.0	20	9.3	5	2.8	6.5
<i>Savannah River:</i>						
Augusta, Ga. ....	32.0	22	21.7	4, 5	8.2	13.5
<i>Willamette River:</i>						
Portland, Oregon ....	.....	20	11.9	2, 3	8.3	3.6

#### FLOODS.

The upper Mississippi river was at a high stage throughout the month, but its maximum height at stations north of Saint Louis, was reached between the 8th and 16th. Extensive damage was done at various places along its banks, in Illinois, Iowa, and Missouri, but from the reports at hand it appears that the flood was most disastrous in the vicinity of Quincy, Ill., where large areas of land under cultivation were inundated and much property destroyed.

In the following table are given the stages of water in the Mississippi River during May, 1888, at certain stations in, or near, the flooded region. The observations were made at 2 p. m. 75th meridian time:

Date	Dubuque.	Davenport.	Keokuk.	Saint Louis.
	Danger-line (16 feet).	Danger-line (15 feet).	Danger-line (14 feet).	Danger-line (32 feet).
	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>
1	17.6	15.4	15.9	21.6
2	17.3	15.0	16.0	21.6
3	16.9	14.5	15.7	21.6
4	17.2	14.3	15.8	22.2
5	18.0	14.1	15.5	22.4
6	19.0	14.0	15.3	22.5
7	19.9	14.3	15.3	22.5
8	20.8	15.1	15.5	22.7
9	21.7	15.9	16.1	23.0
10	22.0	16.6	16.3	23.0
11	22.3	17.4	16.6	23.4
12	22.3	17.9	17.1	24.2
13	22.4	18.3	18.2	24.4
14	22.3	18.5	18.8	24.7
15	22.1	18.6	19.2	25.3
16	21.9	18.6	19.4	25.5
17	21.5	18.5	19.6	25.6
18	21.3	18.4	19.5	25.7
19	20.7	18.1	19.4	26.4
20	20.3	17.9	19.2	26.9
21	19.9	17.5	18.9	26.8
22	19.4	17.2	18.7	26.9
23	18.9	16.6	18.5	27.4
24	18.3	16.3	18.1	27.8
25	17.5	15.7	17.7	27.9
26	16.9	15.2	17.4	27.6
27	16.5	14.8	16.8	27.4
28	16.0	14.4	16.9	27.2
29	15.8	14.0	16.9	27.0
30	15.8	13.3	16.5	27.8
31	16.0	13.0	15.8	28.9

Concerning the flood in the Mississippi River the following reports are given:

Saint Paul, Minn.: the river reached the highest point at noon of the 10th, and began to fall on the 12th. No serious damage resulted from the high water in this vicinity, except on lowlands on the opposite side of the river where the occupants of a few houses were compelled to move to higher places.

Winona, Winona Co., Minn.: there was a further rise of four inches in the river at this place during the night of the 3d-4th. On the 4th about one-third of the town was under water, and hundreds of families were compelled to move.

La Crosse, Wis.: the river reached its highest stage on the 8th and 9th, when some of the farm lands south of this place were submerged, and the people living on the lowlands to the northward moved to higher ground. No serious damage resulted from the overflow.

Dubuque, Iowa: the river rose steadily from the 4th until the 12th, when the highest point, 22.4 feet, was attained, being 0.4 feet below high water mark of 1880. The Illinois Central Railway track south of the depot in this city was from one to two feet under water on the 9th, and all mills and factories had to suspend work, leaving hundreds of people idle. Numerous warehouses and dwellings were also under water, and families moved to higher points for safety. The total loss by the flood is estimated at \$100,000.

Davenport, Iowa: the river rose to the danger-line on the 8th, and continued to rise until the 15th, when its highest point, 18.6 feet, was attained, this being the highest stage recorded since the establishment of the Signal Service station in this city in 1871; the river remained stationary on the 15th and 16th, and on the 17th it began to fall slowly. Several dwellings in the eastern section of the city were flooded, and numerous families had to leave their houses. The Chicago, Burlington, and Quincy, Chicago and Rock Island, and the Chicago, Milwaukee, and Saint Paul railroad tracks were eight inches under water, and all warehouses on the river front were under water up to the first floors. The Rock Island lumber company lost 1,000,000 feet of logs, valued at \$20,000. At Moline, Ill., all the large plough and wagon shops and other factories had to shut down on account of high water, throwing several hundred people out of employment.

Keokuk, Iowa: on the 10th the river gauge showed a depth of 16.6 feet, and on that date the water began to overflow the lumber yards and saw mills at this place, and trains on the Saint Louis, Keokuk, and Northwestern Railway, which had been running over submerged tracks for several days, were discontinued. On the 11th the levee at Alexandria, Mo., gave way, and thousands of acres of rich farm land were inundated to the south and west of Alexandria. On the 14th both the Sny and Indian Grave levees gave way, flooding about 200,000 acres of bottom lands, the greater part of which had been sown in winter wheat, and the farmers residing in the overflowed area were driven from their homes. On the 16th the highest stage of water was reached, 19.6 feet, this being the highest point that has occurred since 1851. At the close of the month it was not possible to calculate the damage resulting from the flood though it was estimated that \$3,000,000 would not cover the losses sustained in the vicinity of Keokuk. The greatest damage probably consisted of the large amount of winter wheat ruined by the breaking of the levees, while the damage to the levees themselves, and the losses resulting from the interruption of traffic, constitute an enormous sum. No loss of life is known to have occurred, and but little stock was lost. This was doubtless due in great measure to the warnings given to those living in the threatened districts. Many business establishments kept their correspondents constantly informed as to conditions of the river, obtaining the information through the Signal Service observer. Railway officials were also kept constantly informed as to the condition of the river, and they in turn distributed the information to points along their lines.

Quincy, Ill.: the great flood of May in the upper Mississippi river caused a vast amount of damage in this vicinity. At the close of April the river had reached a dangerous height and overflowed the lowlands in the vicinity of Alexandria, Mo.,

about thirty miles north of Quincy. The river was nearly stationary during the first few days of the month, but after the 6th it rose steadily and on the 11th had overflowed to such an extent that at this place it was ten miles wide, and hundreds of farms were submerged, the water being several feet deep. The Saint Louis, Keokuk, and Northwestern Railroad discontinued the running of trains north of Quincy, cutting off communication between La Grange, Canton, and Alexandria, Mo. On the 13th the river was within two feet of the highest point attained during the year 1881 and continued to rise. On this date sixty-five miles of railroad track between Hannibal, Mo., and Keokuk, Iowa, were submerged to a depth ranging from six inches to three feet. Within the limits of Quincy the high water caused much inconvenience to foundries and factories, and at the water-works. The breaks in the Indian Grave levee during the night of the 13-14th caused a further rise and consequently an increase in the overflowed area. On the 17th the water reached a height exceeding that of the flood of 1881, leaving only the flood of 1851 with a higher record. On this date the factories in the manufacturing districts were nearly all shut down, and there was more than three feet of water in the water-works. The Sny levee broke in several places immediately above the Hannibal bridge at 6.15 a. m., flooding a thickly populated district, and compelling the inhabitants to move.

Concerning the flood in the vicinity of Quincy, the "Chicago Times" of the 18th contained the following:

Above and below Quincy are over one hundred miles of levees, protecting fully 200,000 acres of the most productive farming lands in the valley. On Sunday morning, 13th, the first break occurred in the great embankment known as the Indian Grave levee. During the day two other crevasses were made, and within a few hours thousands of acres of winter wheat that promised a yield of from forty to sixty bushels to the acre were laid waste. The farmers had been working on the embankment night and day in the hope of saving their homes, and when the flood came a majority of them had barely time to save their families, so sudden and overwhelming was the rush of the torrents.

Outside the embankment was the great river, a solid body of water twenty feet deep, and as soon as a crevasse was made it poured through the opening with a roar that could be heard a long distance. Homes were deserted on a moment's notice from riders who were sent out to give warning of the dangers, in many cases the people being obliged to leave everything and to fly to the bluffs or seek safety in boats. On Monday the Sny Carte levee, an embankment commencing just below Quincy and extending south a distance of fifty-four miles, gave way between Hannibal and Louisiana, and the scenes enacted the day previous were repeated and intensified.

Early in the week the Alexandria levee, thirty miles above Quincy, gave way, completely flooding that thrifty city. The crevasses made in the Sny levee at East Hannibal to-day completed the destruction in all the levee districts. Not an acre of ground in this vast territory can escape the flood, and the loss to farming interests is simply incalculable. Cattle and horses in the fine wooded pastures were overwhelmed in many localities and drowned. The river above and below the city is from ten to fifteen miles broad, covering all the farms on both sides and extending from the bluffs on the Illinois side to the high bluffs in Missouri.

On the dry places on the embankment are hundred of cattle, horses, and hogs without feed and no prospect of drink, except when in danger of being swallowed up by the floods. Far across on the opposite bluffs are gathered hundreds of men, women, and children, many of them utterly destitute, having neither sufficient clothing nor shelter, and some suffering for food, despite the bravery of their more fortunate neighbors, who are making every exertion to relieve their immediate wants.

The "Saint Louis Post-Despatch" of the 19th says:

QUINCY, Ill., May 19.—The river is falling very slowly at this point. Since 2 p. m. Thursday, 17th, when the highest point, 19 feet 9½ inches, was reached, it has fallen four inches. The extent and position of the levees that have given way during the present tremendous rise are as follows: The Hunt levee is in Hancock Co., extending from Warsaw to four and one-half miles above Canton, Mo. It was built in 1879. It is twelve miles long and cost from \$50,000 to \$60,000. This levee enclosed from 16,000 to 17,000 acres of land, largely cultivated and covered with growing crops. At least one hundred families lived in this district, and they are now homeless and destitute.

The Indian Grave levee is eighteen miles long, twelve miles on the river

and six in the two cross levees, one of which is opposite Canton, and the other at the head of the bay, and is entirely within Adams Co. This levee was built in 1879, at a cost of about \$200,000. It inclosed a fertile district of 14,000 or 16,000 acres, land generally improved and planted with growing crops. The amount actually lost in these two districts can only be roughly estimated.

The following reports relate to freshets which occurred in other sections of the country:

Chippewa Falls, Chippewa Co., Wis.: a part of this town was inundated on the 1st compelling several families to move.

Brownsville, Tex.: the Rio Grande river was very high on the 1st and 2d, and overflowed on the latter date in two places between Santa Maria, Tex., and this city. The river began to fall slowly on the 3d.

Fort Benton, Mont.: the Missouri River reached an unusually high stage on the 12th, compelling suspension of work on the bridge now being constructed.

Ishpeming, Marquette, Co., Mich.: about one mile of the Duluth, South Shore, and Atlantic railroad track near here was three feet under water on the 12th.

Marinette, Marinette, Co., Wis.: the Menominee River reached on the 12th the highest stage known for many years.

Galena, Jo Daviess Co., Ill.: on the 12th a large part of this place was inundated to such an extent that boats were used in several streets. The water reached a depth permitting boats to be rowed about the Custom House and Post Office buildings.

Livermore Falls, Androscoggin Co., Me.: some roads in this vicinity were from three to five feet under water on the 12th.

Shakopee, Scott Co., Minn., 12th: the rains of the past week have been unusually heavy, and have caused the Minnesota River to overflow adjacent bottom lands.

The "Kansas City Journal" of May 14th, says:

St. Louis, May 13.—Advises from in the Red River country report that the damage done the Red River Valley during the past ten days is almost beyond computation, and the overflow the largest since 1848. Most of the plantations near the river have been covered with water four to six feet deep, and many miles of fencing, cribs, and barns have been washed down and carried away. Many of the people have lost their household furniture, provisions, and corn. In several places the water extended from the hills of Arkansas to the hills of Texas, a distance of ten to fourteen miles.

New Haven, Conn.: reports from Hartford on the 15th stated that a rise of two and one-half feet had occurred in the Connecticut River since the day previous, and that some of the docks were submerged.

Fort Fairfield, Aroostook Co., Me., 16th: numerous washouts have occurred on the New Brunswick Railroad. A large quantity of lumber was washed away at this place on the 15th.

Lead Hill, Boone Co., Ark., 17th: all streams running into White River in this locality overflowed, causing damage to fences and crops. White River was very high on the above date, overflowed bottom-lands, but did no serious damage.

Hannibal, Mo: the lower part of this place was submerged on the 17th; business was practically suspended in consequence.

Eau Claire, Eau Claire Co., Wis.: more than one hundred families were compelled to vacate their homes on account of the flood on the 18th.

Stockton, Rooks Co., Kans., 26th: the heavy rain during the night of the 25-26th caused the Solomon River to flood the adjacent lowlands.

Atchison, Kans.: streams in this section were greatly swollen by the heavy rains of the 26th, and many washouts occurred.

Tilden, Madison Co., Nebr., 27th: the recent heavy rains have swollen the Elkhorn River and caused washouts in the surrounding country.

#### HIGH TIDES.

Southport, N. C., 21st, 24th, 30th; Cedar Keys, Fla., 25th; Wilmington, N. C., 28th, 29th.

### ATMOSPHERIC ELECTRICITY.

#### THUNDER-STORMS.

From the accompanying table it will be seen that thunder-

storms were reported from the largest number (thirty-three) of states or territories on the 28th, and that they occurred in